

PATENT COOPERATION TREATY

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INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)



(PCT Article 36 and Rule 70)

Applicant's or agent's file reference GHS/P504105WO	FOR FURTHER ACTION		See Form PCT/PEA/416
International application No. PCT/GB2004/004391	International filing date (day/month/year) 15.10.2004	Priority date (day/month/year) 30.10.2003	
International Patent Classification (IPC) or national classification and IPC C07C29/00, C07C29/141, C07C29/145			
Applicant DAVY PROCESS TECHNOLOGY LIMITED et al			

1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 6 sheets, including this cover sheet.
3. This report is also accompanied by ANNEXES, comprising:
 - a. ☐ sent to the applicant and to the International Bureau a total of sheets, as follows:
 - ☐ sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).
 - ☐ sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.
 - b. ☐ (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).

4. This report contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the international application
- ☐ Box No. VIII Certain observations on the international application

Date of submission of the demand 30.08.2005	Date of completion of this report 20.01.2006
Name and mailing address of the international preliminary examining authority:  European Patent Office - P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Tx: 31 651 epo nl Fax: +31 70 340 - 3016	Authorized Officer English, R Telephone No. +31 70 340-2860 

**INTERNATIONAL PRELIMINARY REPORT
ON PATENTABILITY**

International application No.
PCT/GB2004/004391

Box No. I Basis of the report

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.
- ☐ This report is based on translations from the original language into the following language , which is the language of a translation furnished for the purposes of:
- ☐ international search (under Rules 12.3 and 23.1(b))
 - ☐ publication of the international application (under Rule 12.4)
 - ☐ international preliminary examination (under Rules 55.2 and/or 55.3)
2. With regard to the **elements*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report):*

Description, Pages

1-19 as originally filed

Claims, Numbers

1-29 as originally filed

- ☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing
3. ☐ The amendments have resulted in the cancellation of:
- ☐ the description, pages
 - ☐ the claims, Nos.
 - ☐ the drawings, sheets/figs
 - ☐ the sequence listing (*specify*):
 - ☐ any table(s) related to sequence listing (*specify*):
4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
- ☐ the description, pages
 - ☐ the claims, Nos.
 - ☐ the drawings, sheets/figs
 - ☐ the sequence listing (*specify*):
 - ☐ any table(s) related to sequence listing (*specify*):

* If item 4 applies, some or all of these sheets may be marked "superseded."

**INTERNATIONAL PRELIMINARY REPORT
ON PATENTABILITY**

International application No.
PCT/GB2004/004391

Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes: Claims	1-29
	No: Claims	
Inventive step (IS)	Yes: Claims	1-29
	No: Claims	
Industrial applicability (IA)	Yes: Claims	1-29
	No: Claims	

2. Citations and explanations (Rule 70.7):

see separate sheet

Re Item V

**Reasoned statement with regard to novelty, inventive step or industrial applicability;
citations and explanations supporting such statement**

Reference is made to the following documents:

D1: US 5 026 927 A (M.A. Andrews, et al.) 25 June 1991

D1: US 3 935 284 A (W.M. Kruse, et al.) 27 January 1976

1. Subject-matter

The present application concerns a process for the production of glycols (page 1, line 1) by hydrogenolysis of a sugar feedstock in the presence of a catalyst comprising ruthenium or osmium and an organic phosphine in the presence of water at a temperature greater than 150 °C (claim 1). This process also yields the undesired glycerol (see examples).

2. Novelty

Document D1 (claim 1) describes a method for the hydrocracking of carbohydrates (mono-, di- or pretreated polysaccharides) in the presence of ruthenium- and osmium-containing catalysts with triphenylphosphine and, optionally, other ligands. D1 indicates that the process can be carried out at a temperature of between 25 °C and 200 °C (column 3, lines 35 to 37) or more particularly between 50 °C and 150 °C (claim 10). Water can be used as the solvent (column 3, lines 15-16; claim 9; examples 2-6,8-10 and column 4, lines 16-17).

All the features of present claim 1, namely that the catalyst comprises ruthenium or osmium and an organic phosphine and that the hydrogenolysis is performed in the presence of water at a temperature of greater than 150 °C, are disclosed in D1. Thus, the subject-matter of present claim 1 constitutes in part a selection of that disclosed in D1.

What has to be established with regard to novelty is whether the state of the art is such as to make the subject-matter of the invention available to the skilled person in a technical teaching. For novelty to be established, the selected sub-range

(a) should be narrow with respect to the known range;

(b) should be sufficiently far removed from the preferred part of the known range and must not cover any examples in the prior art; **and**

(c) should not be an arbitrarily chosen specimen from the prior art, i.e. not merely one way of carrying out the prior teaching, but must provide a new invention (purposive selection).

The process in the examples of D1 is carried out using a ruthenium triphenylphosphine catalyst in N-methyl-2-pyrrolidinone as solvent, at a temperature of 100 °C (and in one case at 50 °C) and, in the case of examples 2-6,8-10, in the presence of water (in the form of a quantity of aqueous potassium hydroxide). There are no examples in D1 where it is carried out at a temperature of greater than 150 °C.

Since the presence of water has been shown to be necessary for the reaction to be carried out at the higher temperature (see paragraph 3, below), the process of claim 1, in so far as it overlaps with that of D1, appears to be a narrow selection and is not an arbitrarily chosen selection. None of the examples falls within the claimed temperature range.

Although D1 discloses carrying out the reaction in the presence of water (examples 2-6,8-10; claim 9; column 3, lines 15-16) and at a temperature greater than 150 °C (column 3, lines 35 to 37; claim 10), it is not stated or even implied that these two features are preferred, especially in conjunction with each other as in the present claim 1. Thus, it is considered that the subject-matter of present claim 1 is far removed from the preferred part of the known range.

It appears that all three of the criteria for novelty of a selection invention given above are satisfied and, consequently, the subject-matter of claim 1 and dependent claims 2-29 is considered to be novel with respect to D1.

3. Inventive step

The document D1 is regarded as being the closest prior art to the subject-matter of claim 1 and, as noted in paragraph 2 above, discloses a process for hydrocracking a mono-, di- or pretreated polysaccharide. The process of the present invention differs from that of D1 in that in the former the presence of water is required and a higher temperature is used.

The examples in D1 show that at 100 °C and 20.7 bar (300 psi) hexitols are the main product and a substantial amount of glycerol and very little ethylene glycol and propylene glycol are formed. The present application (example 59) suggests that when the hydrogenolysis is carried out at 150 °C (i.e. just below the claimed temperature range) and 69 bar (1000 psig) the conversion is low but there is some selectivity towards ethylene glycol and propylene glycol. Tables 1 and 13 show that at 190 °C, 200 °C and 225 °C, the hydrogenolysis conversion is much greater but a large amount of glycerol is still being formed and that only at 250 °C is this substantially reduced. However, the selectivity of the reaction towards glycols in the claimed temperature range (greater than 150 °C) is always better than at the lower temperatures exemplified in D1.

The problem to be solved by the present invention may therefore be regarded as the provision of an improved process for the hydrogenolysis of a sugar feedstock. The applicant solves this problem by means of the hydrogenolysis process of claim 1, in particular, carried out in the presence of water and at a temperature above 150 °C.

Document D2 discloses (column 5, lines 19-29) that in general at temperatures much above 150 °C, a ruthenium triphenyl phosphine catalyst decarbonylates the substrate and becomes inefficient. In the light of this teaching, the skilled person would not expect any improvement in the yield and selectivity of the process when carried out substantially above 150 °C even in the presence of water.

Thus, there is nothing in D1 or D2, or anywhere else in the prior art, to suggest that, in the presence of water, the use of a temperature of 150 °C or above would lead to the increased yield and increased selectivity towards glycols in the hydrogenolysis. Consequently, the subject-matter of claim 1 and of dependent claims 2-29 appears to involve an inventive step and to satisfy the requirements of Article 33(3) PCT.